

# Fact Sheet

## Scalability and Rural Development

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### 1 What Is Scalability?

Scalability refers to the extent to which a system, a component or a process is scalable. Scalable systems, components or processes do not need to be replaced or changed when scale is increased. Hence, scalability represents a potential for growth. For this reason, scalability is often used as a design criterion, either for technical designs or for business plans.

In the context of rural development, scalability may be a property of technologies, technological designs, dissemination mechanisms, organisational arrangements, networks etc. Scalable innovations for rural development can both be *embodied* in capital goods or products (e.g. a rural ICT system) or *disembodied* (e.g. agricultural management practices).

### 2 Why Scalability Is Important For Rural Development

Scalability is a desirable property when an organisation or a technology needs to be effective on a large scale. This is often the case in agriculture for a number of reasons:

- **Poverty Reduction:** The United Nations Millennium Declaration includes the goal of halving the proportion of people whose income is below the poverty line of one dollar a day and halving the proportion of people who suffer from hunger. With 900 million rural poor living below the poverty line, it is obvious that this goal requires social, economic and technical change on a large scale.
- **Increased Demand for Agricultural Products:** An increase of the world population to 8.3 billion by the year 2030, an increased use of biofuels and a changing diet in developing countries require significant higher levels of agricultural production. This requires large scale innovation.
- **Sustainable Development:** Making agriculture sustainable requires large scale innovation as it involves a large number of farms in a wide range of social, economic and physical environments. The increasing demand for agricultural products entails both challenges and opportunities for sustainable agriculture. Large scale innovation is needed to meet these challenges and to take advantage of these opportunities.
- **Food Quality Management:** Managing food quality requires collaboration between all parties involved in the food chain. As food manufacturers obtain their raw materials from a large amount of farmers, scale is an important issue in managing food quality.
- **Corporate Responsibility:** Companies often obtain raw materials like coffee, tea or cocoa from a large amount of smallholders. If these companies are committed to running a socially

just and environmentally sound business, they must collaborate with many farmers.

- **Organisational Growth:** Organisations may wish to grow for various reasons like economic growth, getting enough critical mass or creating more impact. They may grow by uptake of new activities or by expanding current activities.

Scalable solutions offer advantages over non-scalable solutions as:

- **Scalable systems, components or processes can support scale increases without requiring extra costs** (e.g. for redesign or replacement). Scale increases that are subject to diminishing returns or returns to scale, imply increasing costs. While the costs *per unit* of output decrease in case of increasing returns to scale, the total costs still increase. Furthermore, such a decrease of costs per unit of output often has an optimum beyond which returns to scale remain constant or start to decrease.
- **Scalable solutions for rural development are relevant within a range of social, environmental and economic circumstances.** Therefore, scalable solutions meet both the “Contextualist Principle” which gives primacy to local needs and contexts as well as the “Universalist Principle” that is based on the belief that universal solutions can be widely applicable to problems.

### 3 Related Terms

Because the need to increase the scale of rural development processes is widely recognised, a number of related terms has been used to describe different processes that relate to scale increase:

- **scaling up (1):** *increasing the number, the size, the quantity or the level of activity. For example, a bottom line definition of scaling up was formulated during the Going to Scale workshop that was held in the Philippines in 2000: “more quality benefits to more people more quickly more equitably more lastingly over a wider geographical area”.*
- **scaling up (2):** *passing experience, knowledge, impact and effects higher up the hierarchy of an organisation or a society.*
- **scaling down:** *applying the knowledge that is available on higher levels of the hierarchy of an organisation or society on lower hierarchical levels.*
- **scaling out:** *passing experience, knowledge, impact and effects to other parties with whom is no hierarchical relation.*
- **scaling up horizontally:** *passing experience, knowledge, impact and effects to other parties with whom is no hierarchical relation. This is a synonym of scaling out. In system analysis, scaling up horizontally means adding more nodes to a system.*
- **scaling up vertically:** *passing experience, knowledge, impact and effects higher up the hierarchy of an organisation or a society. This is a synonym of scaling up (2). In system analysis, scaling up vertically means adding resources to a single node in the system so that it can handle more throughput.*

### 4 Diminishing Returns, Returns To Scale And Scalability

The so-called *production function* can be used to explain the idea of scalability and link it to the concepts of diminishing returns and returns to scale. In standard undergraduate economic theory, the

production function represents production within a fixed period of time by  $Q = F(L, K)$ , in which:

- Q stands for the quantity produced or output. This may be a physical quantity but it may also refer to services.
- L and K are the so called production factors or input. L stands for Labour and K stands for Capital.
- F means that the quantity produced is a function of Labour and Capital. F is the quality of the production process and is approached as a black box. In an abstract sense, F is often called “technology” but this may also refer to the organisation used.

**Diminishing returns** refer to a situation in which an additional unit of a single variable input yields a decreasing amount of additional output. For example; if you keep adding nitrogen to a crop without changing other factors that influence the yield, you'll reach a point beyond which each additional unit of nitrogen results in less and less additional yield. If the Law of Diminishing Returns applies, then  $F(2L, K) < 2 F(L, K)$ .

**Increasing returns to scale** occur when the amount of total output rises more than proportionately with an increase of all production factors. If this occurs, then  $F(2L, 2K) > 2 F(L, K)$ . This occurs when increasing the scale results in producing more efficiently.

**Decreasing returns to scale** occur when the amount of total output rises less than proportionately with an increase of all of the production factors. This happens for example when the costs of management increase more than proportionally when the scale is increased. If this occurs, then  $F(2L, 2K) < 2 F(L, K)$ .

**Constant returns to scale** occur when the amount of total output rises proportionally with an increase in all of the production factors. In this case,  $F(2L, 2K) = 2 F(L, K)$ .

**Scalability** occurs when the quantity of a production factor does not determine its effect. Suppose software is part of the production function F and F is subject to constant returns to scale so that  $Q = F(L, K)$  and  $F(2L, 2K) = 2 F(L, K)$ . After breaking software out as a separate input factor, the production function is written as  $Q = G(L, K, S)$  in which S stands for software. G stands for a different production function depending on other technology than software. As the software has already been written, increasing the amount of labour and capital does not require more software, so  $G(2L, 2K, S) = 2G(L, K, S)$ . In this case, the production factor S is scalable.

## 5 Scalability And Complexity

Increasing the scale of a system, a process or a component has different effects on complexity:

- A **single component** is scalable within the range in which it is able to handle additional workload without being changed or replaced. If such a scale increase occurs, the single component does not increase the complexity of the system or process.
- When **additional components** are added to a scalable **system** or **process**, the complexity of the system or process increases linearly.

## 6 Using Scalability In Rural Development

In order to make use of scalability in rural development, research programs and rural development programs must take into account that:

- **Scalability cannot be an afterthought, it should be addressed during planning and design.** An organisation, a mechanism for dissemination, a technology etc. is either scalable or not. Once a design has been created, it cannot be made more scalable by convincing, talking, empowering etc. In order to make an unscalable system, process or component scalable, it needs to be redesigned.
- **Scaling up the results of pilot projects is often problematic.** It is common practice in rural development programmes to start a pilot first. Often, such pilots offer room for participatory research. This ensures that local circumstances are taken into account when solutions are designed. This pilot-first approach suffers of two problems: At first, pilot projects and participatory research projects create artificial framework conditions. Other farmers live in other circumstances that are less affected by the presence of the pilot project. These farmers may have more difficulties adopting the designed solutions. Secondly, pilots focus on locally specific circumstances while scalable solutions are widely applicable.
- **As a solution, scalability should be included as a design criterion or 'pre-analytical' choice** before the pilot or the design phase starts.
- **There is no recipe for scalability.** Although scalable systems, processes and components share a similar kind of behaviour, the causes of this behaviour is found in the underlying organisation and technology. In each case, scalability should be considered separately.

## 7 Examples

- **Design:** Zero Tillage is an example of a scalable technology design. At first, the technology was designed for the South of Brazil. As farmers played a leading role in its design, the technology was relevant for them and adoption occurred very fast during the 1990ties. In a later phase, the zero tillage technology was redesigned for the conditions of the Brazilian Cerrado. Once the technology was made scalable within the Cerrado region, the adoption rate became very high in this region.
- **Dissemination:** Farmer to Farmer approaches are examples of scalable dissemination mechanisms. Such mechanisms do not need to be changed when the scale is increased: The more farmers get involved, the more farmers act as ambassadors of a certain innovation.
- **Technology:** Online weather reports or websites with market price information are examples of scalable technologies: if more farmers use these websites, the costs of operating them will not increase.

## 8 About This Fact Sheet



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